



US009241594B2

(12) **United States Patent**
Rodriguez et al.

(10) **Patent No.:** **US 9,241,594 B2**
(45) **Date of Patent:** **Jan. 26, 2016**

(54) **BEVERAGE BREWING SYSTEM AND METHOD**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1714 days.

(21) Appl. No.: **12/475,310**

(22) Filed: **May 29, 2009**

(65) **Prior Publication Data**

US 2010/0303983 A1 Dec. 2, 2010

(51) **Int. Cl.**
A47J 31/057 (2006.01)
A47J 31/44 (2006.01)

(52) **U.S. Cl.**
CPC **A47J 31/44** (2013.01)

(58) **Field of Classification Search**
CPC A47J 31/40; A47J 2201/00; A47J 31/057
USPC 99/270, 300, 307
See application file for complete search history.

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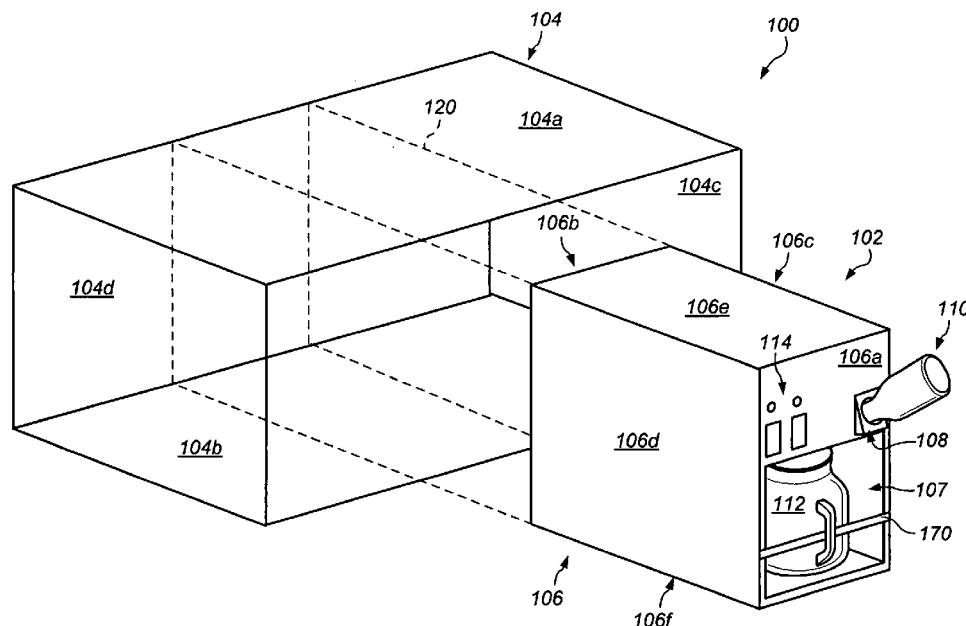
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(57) **ABSTRACT**

Provided in some embodiments is a beverage brewing device that includes a housing and a fill-port located on front side of the housing. The fill-port includes an inlet that may accept a fluid supply container. Provided in some embodiments is a method of preparing a brewed beverage that includes coupling a fluid supply container to a fill-port located on a front side of a brewing device, routing a fluid contained in the fluid container from the fluid container to a heat-exchange device to heat the fluid, routing the heated fluid to a brewing container to brew the fluid, and routing the brewed fluid into a beverage container used for serving the brewed beverage.

26 Claims, 4 Drawing Sheets



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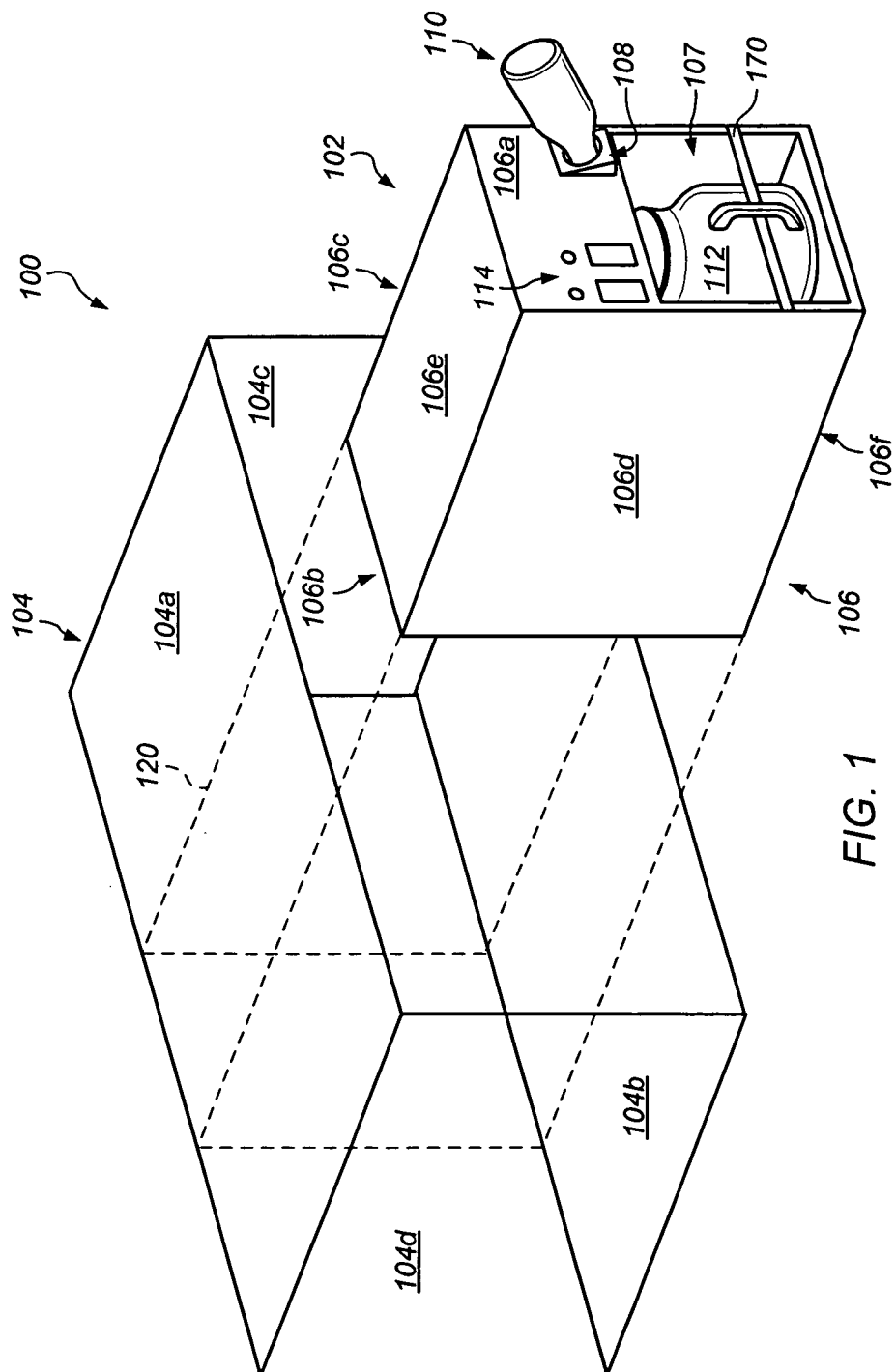
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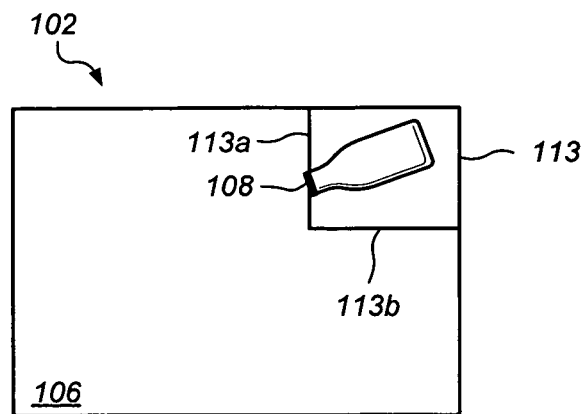


FIG. 2A

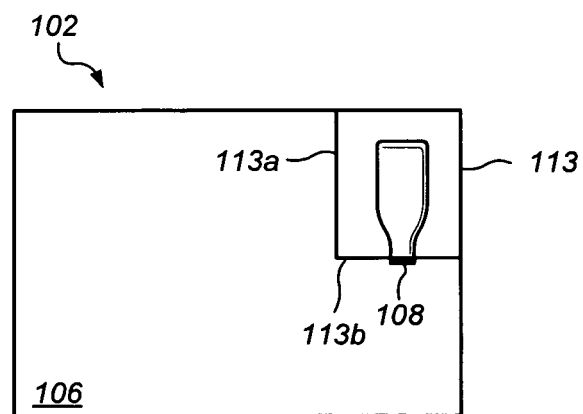


FIG. 2B

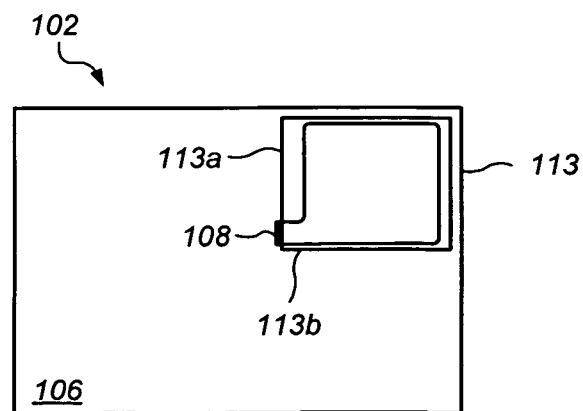


FIG. 2C

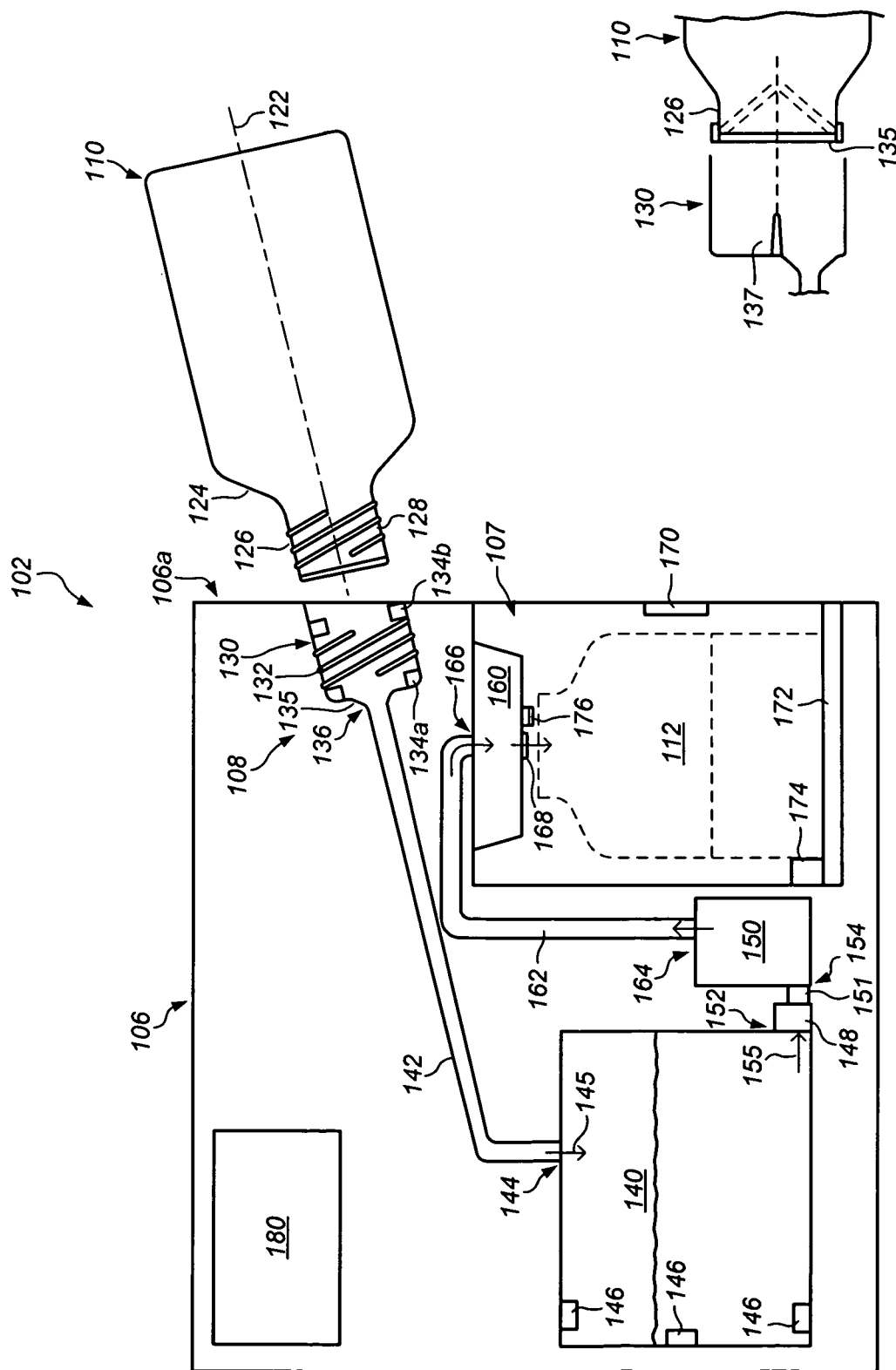


FIG. 3A

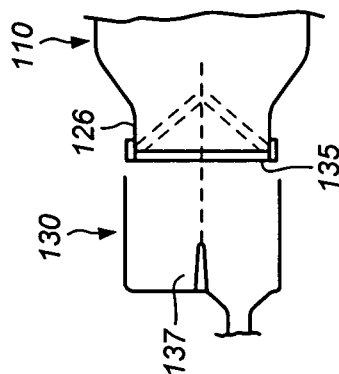


FIG. 3B

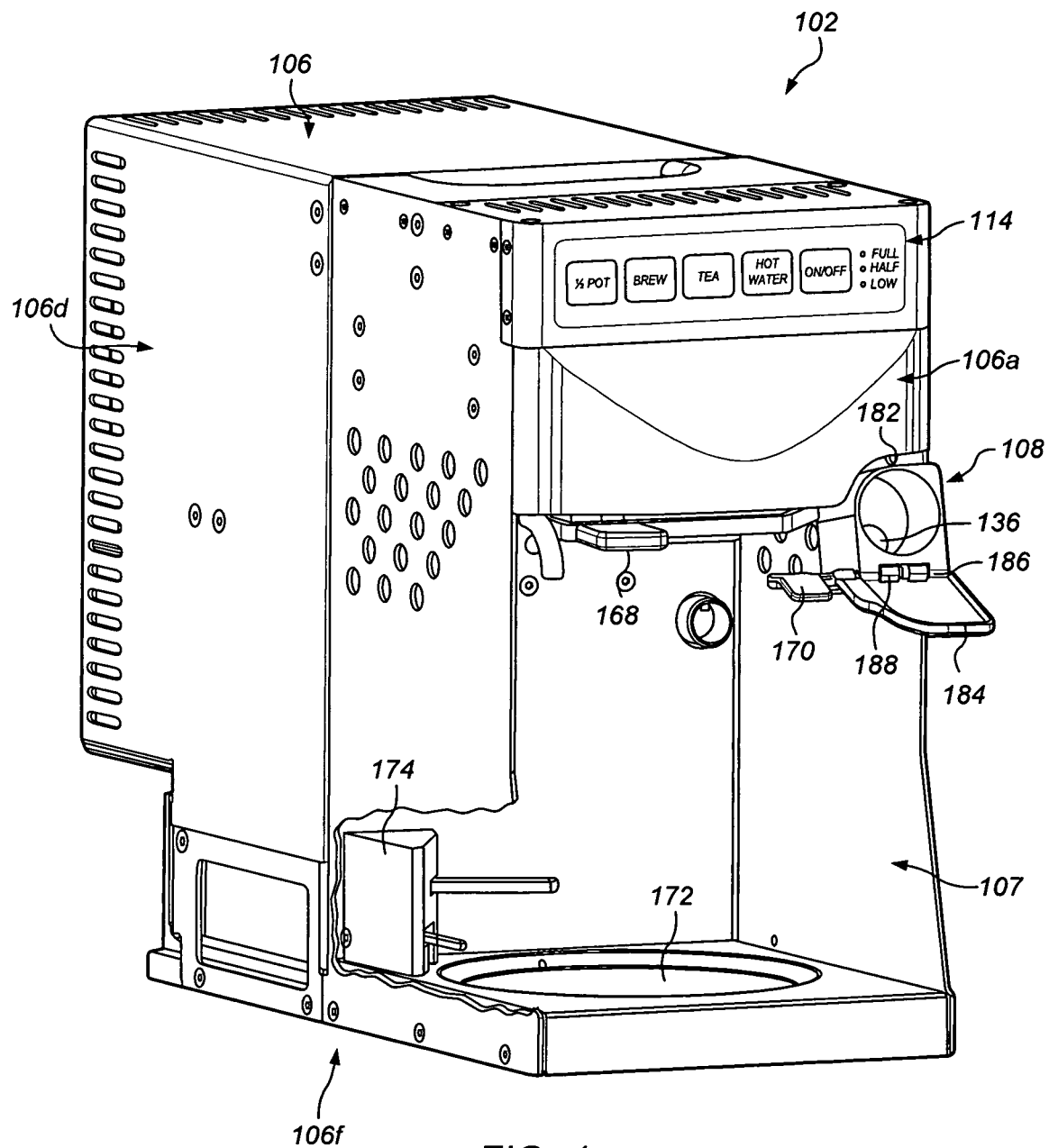


FIG. 4

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BEVERAGE BREWING SYSTEM AND METHOD

BACKGROUND

1. Field of the Invention

The present invention generally relates to systems and methods for brewing beverages and more particularly to a brewing system and method suitable for use in aircraft.

2. Description of Related Art

Brewed beverages, such as coffee, cappuccino, espresso, tea, and the like, are popular among a large portion of the population. Brewed beverages are often brewed and served in the home, places of business, restaurants, cafes, coffee shops, and on aircraft, among other locations. Traditionally, coffee and other beverages are brewed on-site and served warm. Accordingly, the brewing devices used for making brewed beverages are usually located in the respective homes, places of business, restaurants, cafes, coffee shops, aircraft, or other locations.

Over the years numerous brewing devices have been developed to accommodate preparing and serving brewed beverages at various locations. On aircraft, however, regulations may limit the location of fluids, such as water and coffee, with respect to electrical components in the aircraft. Such regulations may help to ensure that any leaks or spills do not affect operation of the aircraft. Unfortunately current aircraft beverage brewers, such as coffee makers, may require removal or significant movement of a brewing device which may lead to fluid leaking or spilling within the aircraft. For instance, a spill may occur when a coffee maker installed under a shelf or other obstruction in an aircraft's galley, is removed or slid-forward for cleaning, or moved to pour water into a top-fill of the coffee maker, or the like. Further, aircraft regulations may limit the temperature and quantity of heated fluids, such as water. These regulations may help to ensure that aircraft operators and passengers are not injured by heated water or coffee spilled due by turbulence or other disruptions.

In addition to design considerations with respect to the aircraft, the source of the water used to brew a beverage may be of concern. For instance, the type and quality of water used to brew coffee can significantly affect the overall flavor of the coffee. Unfortunately, when traveling around the world, aircraft often refill with water from local water supplies local to the airport where they are located. This can result in inconsistent and undesirable flavor due to the various types and qualities of water used. Accordingly, it may be desirable that a consistent type and quality of water be used to provide a flavorful quality coffee.

In view of these and other concerns, it may be desirable that a brewing device, such as an aircraft coffee maker, fit within certain space limitations of an aircraft's galley, reduce the likelihood of leakage or spillage of fluids, and capable of receiving fluids from a quality source.

SUMMARY

Various embodiments of coffee brewing systems and related apparatus, and methods of operating the same are described. In one embodiment, provided is a beverage brewing device that includes a housing having a fill-port located on a front side of the housing. The fill-port includes an inlet that accepts a fluid supply container.

In another embodiment, provided is a beverage brewing system that includes a rack for securing one or more modular devices and a modular brewing device that may fit within the rack. The modular brewing includes a housing that may be

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secured within the rack and a fill-port located on a front side of the housing. The front side of the housing and the fill-port is substantially accessible when the housing is secured within the rack. The fill-port includes an inlet that accepts a fluid supply container.

In yet another embodiment, provided is a method of preparing a brewed beverage that includes coupling a fluid supply container to a fill-port located on a front side of a brewing device, routing a fluid contained in the fluid container from the fluid container to a heat-exchange device to heat the fluid, routing the heated fluid to a brewing container to brew the fluid, and routing the brewed fluid into a beverage container used for serving the brewed beverage.

BRIEF DESCRIPTION OF THE DRAWINGS

Advantages of the present invention will become apparent to those skilled in the art with the benefit of the following detailed description and upon reference to the accompanying drawings in which:

FIG. 1 is an illustration of a brewing system in accordance with one or more embodiments of the present technique.

FIGS. 2A-2C are diagrams of a brewing device of the brewing system in accordance with one or more embodiments of the present technique.

FIGS. 3A-3B are diagrams of a brewing device of the brewing system in accordance with one or more embodiments of the present technique.

FIG. 4 is a perspective view of an embodiment of the brewing device in accordance with one or more embodiments of the present technique.

While the invention is susceptible to various modifications and alternative forms, specific embodiments thereof are shown by way of example in the drawings and will herein be described in detail. The drawings may not be to scale. It should be understood, however, that the drawings and detailed description thereto are not intended to limit the invention to the particular form disclosed, but to the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the present invention as defined by the appended claims.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

As discussed in more detail below, certain embodiments of the present technique include a system and method for brewing a beverage, such as coffee, cappuccino, espresso, and the like. In certain embodiments, a brewing system includes a brewing device (e.g., a coffee maker) suitable for use on an aircraft. The brewing system includes, in some embodiments, a front-fill port that enables filling of the brewing device with a fluid from a front-side of the brewing device. In certain embodiments, a user may fill the brewing device from the front side without having to access other portions of the brewing device and/or remove the brewing device from a rack-mount or similar location. Further, in certain embodiments, the fill-port includes a nozzle that is configured to receive a fluid container, such as a bottle of water. When coupled to the nozzle, in some embodiments, the water bottle is in fluid communication with a reservoir and/or conduit such that water can be supplied to the brewing device via the water bottle. In some embodiments, the water bottle is located above the storage tank such that water is gravity-fed from the water bottle into the storage tank. Further, in certain embodiments, the brewing device includes a heating system that is configured to heat the water on-demand. In other words, the

water is heated on an as-needed basis as opposed to heating the entirety of the water in a reservoir during a single brewing cycle. In some embodiments, the heating system includes an in-line heating element operated to selectively heat a reduced quantity of water (e.g., a single cup). Further, in some embodiments, the brewing device includes one or more sensors (e.g., pressure sensors or ultrasonic sensors) to detect the water level in one or both of the reservoir and/or a serving container (e.g., a coffee pot). The sensors are configured to detect when the water level is low or high in the reservoir and/or the serving container, in some embodiments. As discussed in more detail below certain embodiments include additional variations and arrangements of features that may be employed in one or more embodiments of the present technique.

Turning now to FIG. 1, depicted is a perspective view of a beverage brewing system **100** in accordance with one or more embodiments of the present technique. Brewing system **100** includes a brewing device **102** and a rack-mount **104**. As described in further detail below, brewing device **102** may be inserted into and secured to rack-mount **104** during use of brewing system **100**. As depicted, brewing system **100** includes a fill-port that is accessible from a front-side of the system such that a user can add a fluid to brewing device **102** without having to remove it from the brewing system **100** and/or the rack-mount **104**. Such an embodiment may be useful in an environment, such as on aircraft, where space is limited, other devices are located above, below and/or to the sides of brewing device **102**, and there is a desire to reduce the likelihood of spilling fluids used to supply the brewing device **102**. Further, in one embodiment, a water bottle can be coupled to a nozzle of the fill-port. Such an embodiment may enable portable water bottles, such as those typically sold with bottled water, to be coupled to brewing device **102**. In one embodiment, brewing system **100** may be configured to brew coffee. In such an embodiment, brewing device **102** may include a coffee-maker that is used to heat water, pass the water over coffee grounds, and dispense a resulting brewed coffee beverage for consumption. Other embodiments of brewing system **100** may include devices for preparing cappuccino, espresso, tea, other brewed/heated beverages, or a combination thereof.

In the illustrated embodiment, brewing device **102** includes a housing **106**, a fill-port **108**, a supply container **110**, a serving container **112**, and controls **114**. In one embodiment, a supply fluid (e.g., tap water from a local water supply, filtered water, bottled water, or the like) is provided to brewing device **102** via fill-port **108**. For example, in one embodiment, supply container **110** containing a supply fluid, such as water, is disposed into fill-port **108**. The supply fluid may be routed from supply container **110** to a fluid reservoir via fill-port **108** and subsequently routed to a heating device where the fluid is elevated to a temperature suitable for brewing. The heated fluid may then be routed to a brewing location where it is introduced to a brewing medium, such as ground coffee beans. The heated fluid may take on characteristics of the brewing medium (e.g., the flavor of the ground coffee beans), and may be subsequently dispensed. For instance, in the illustrated embodiment, brewed coffee may be dispensed into serving container **112** (e.g., a coffee pot).

Supply container **110** may include a container suitable for containing and distributing fluid to brewing device **102**. In one embodiment, supply container **110** includes an opening (e.g., a nozzle) that can be inserted into fill-port **108** such that fluid can be transferred from supply container **110** into brewing device **102** via fill-port **108**. For example, supply container **110** may be coupled (e.g., threaded into) to fill-port **108**

such that fluid can be transferred from supply container **110** to brewing device **102** via fill-port **108**. In one embodiment, the contents of supply container **110** may be poured into fill-port **108** without coupling supply container **110** to fill-port **108**. For example, fill-port **108** may include a funneling device that receives and directs water into brewing device **110**.

Supply container **110** may take various forms, such as common water bottles used to transport, sell, and/or consume beverages. For example, supply container **110** may include a plastic bottle having a nozzle, such as a plastic bottle typically associated with bottled water. In one embodiment supply container **110** may include a cylindrical plastic bottle having a necked portion and a threaded nozzle that can be inserted, threaded, or otherwise coupled to fill-port **108**. Accordingly, an operator (e.g., a flight attendant) may use a common water bottle, such as those typically purchased off-the-shelf, to fill/supply brewing device **102**. Supply container **110** may include a container specifically designed to interact with brewing device **102** and fill-port **108**. For example, supply container **110** may include a shape that is complementary to a feature of brewing device **102**, such as a depression in housing **106**, as described in more detail below with respect to FIGS. 2A-2C. The opening (e.g., nozzle) of supply container **110** may be complementary to fill-port **108**. A nozzle of supply container **110** may include threads, detent features, a shape (e.g., square or round), keying features or the like that engage fill-port **108**. For example, a nozzle of supply container **110** may include threads that are complementary to threads of a nozzle of fill-port **108**, as described in more detail below with respect to FIG. 3.

Housing **106** may include an enclosure that houses certain components of brewing device **102**. In one embodiment, housing **106** may be formed from metal, plastics, composites, or the like. In the illustrated embodiment, housing **106** includes a generally box-like shape having six faces defining its exterior. More specifically, housing **106** includes a front face **106a**, a back face **106b**, a right face **106c**, a left face **106d**, a top face **106e**, and a bottom face **106f**. In the illustrated embodiment, each of faces **106a-106f** is substantially planar flat face. In other embodiments, various shapes that form the exterior of housing **106** may define faces **106a-106f**. For example, faces **106a-106f** may have protrusion, depressions, recess, or the like that also define faces of the housing. In other words, in some embodiments, the faces of brewing device **102** may be defined by the direction portions of the brewing device **102** are facing or accessible from. Front face **106a** includes a portion of the housing that is generally accessible from a front side of the brewing device **102** during use. The front side may be defined as the side of the brewing device that includes a majority of controls, inputs, serving containers, and other portions that are accessed during normal use of the brewing device. For example, front face **106a** may include a face that faces outward from a rack-mount when installed such that front face **106a** is accessible by a user. Further, surrounding components, devices, or the like may not substantially obstruct front face **106a**. Front face **106a** thus may be generally accessible even when brewing device **102** is inserted into rack-mount **104**. As described in more detail below, when brewing device **102** is installed into rack-mount **104**, access to other portions of housing **106**, such as top-face **106e** and bottom-face **106f** may be obstructed by walls of rack-mount **104** and/or other devices installed in rack-mount **104**. Housing **106** also includes an opening **107** that is shaped to accept serving container **112**. In the illustrated embodiment, opening **107** includes a recess in front face **106a** that extends inward toward an interior of housing **106**.

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FIGS. 2A-2C illustrate various embodiments of brewing device **102** in accordance with one or more embodiments of the present technique. More specifically, FIG. 2A depicts an embodiment that includes a pocket **113** in front face **106a**. Pocket **113** completely houses supply container **110** when it is inserted/engaged with fill-port **108**. In other words, supply container **110** is recessed into pocket **113** such that a majority, substantially all, or all of supply container does not extend beyond a plane substantially defining front face **106a** or other components located on front face **106a**. Such a design may reduce the likelihood of a passer-by accidentally bumping into, dislodging and/or damaging supply container **110**. In the illustrated embodiment, pocket **113** includes a rectangular shape and fill-port **108** is located on a back face **113a** of pocket **113**. Other embodiments may include variations in the shape of pocket **113** and location of fill-port **108**.

FIG. 2B illustrates another embodiment in which fill-port **108** is located on a bottom face **113b** of pocket **113**. As depicted, this may enable supply container **110** to be oriented in a substantially vertical configuration. Such an orientation may help to ensure that all or substantially all of fluid in supply container **110** is deposited into brewing device **108**.

FIG. 2C illustrates an alternate embodiment that includes a pocket **113** having a shape that substantially conforms to a shape of supply container **110**. As described above, supply container **110** is recessed into pocket **113** such that a majority, substantially all, or all of supply container does not extend beyond a plane substantially defining front face **106a** or other components located on front face **106a**. More specifically, in the illustrated embodiment, pocket **113** includes a substantially rectangular shape enclosed on three sides and supply container **110** includes a substantially rectangular shape that is complementary to the shape of pocket **113**. Such an embodiment may enable modular supply containers to be used and interchanged. In the illustrated embodiment, fill-port **108** is located on a lower portion of back face **113a** of pocket **113**, and the nozzle of supply container **110** is located in a complementary position substantially near the bottom of supply container **110**. Other embodiments may include any suitable arrangements of supply container **110** and/or fill-port **108**. For example, fill-port **108** may protrude from front face **106a** such that all, substantially all or only a portion of supply container **110** extends from front face **106a** and/or is not contained within a pocket or similar recess. Fill-port **108** may be located on other faces of housing **106**, pocket **113**, or the like that are readily accessible when brewing device **102** is positioned for use (e.g., installed in rack-mount **104**).

In some embodiments, brewing device **102** may include additional controls and/or indicators. An operator may use the controls/indicators to set certain characteristics of operation and/or to assess certain operational characteristics. Controls/indicators may be used to start/stop a brewing cycle, to set brewing parameters (e.g., brewing temperature), to assess a water level in a reservoir or the serving container, and/or to assess whether an error has occurred with the brew cycle. Controls/indicator may include buttons, light-emitting diodes (LEDs), and the like for input and observation by an operator. In the illustrated embodiment, brewing device **102** includes controls/indicators **114** located on front-face **106a** of the housing **106**. Other embodiments may include controls located on various faces of housing **106**, such as a master power switch located on a side or rear face of housing **106**.

In some embodiments, rack-mount **104** may include a rack, a modular-rack, a shelf, cabinet, or the like used for mounting brewing device **102**. In one embodiment, rack-mount **104** includes a modular-rack of an aircraft used to house one or more modular devices. Such a rack-mount may typically be

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used in the kitchen/galley of aircraft, trains, buses, or other transportation vehicles. Rack-mount **104** may be used to house modular units, such as modular coffee-makers, modular refrigerators, modular storage bins, and the like. Modular-racks may be characterized by common width, depth, and/or mounting features that enable the exchange one modular unit with another modular unit. For example, in the illustrated embodiment, the box-shaped housing **106** of brewing device **102** may slide into one or more modular racks of rack-mount **104** as indicated by dashed lines **120**. When brewing device **102** is installed in rack-mount **104**, certain portions of rack-mount **104** and/or other device may obstruct, block, and/or prevent access to one or more portions of brewing device **102**. For example, when brewing device **102** is installed into to rack-mount **104**, a top-rack portion **104a** and a bottom-rack portion **104b** of rack-mount **104** may block access to top-face **106a** and bottom face **106f**, respectively. Similarly a side-rack portion **104c**, back-rack portion **104d** or other devices installed in adjacent slots of rack-mount **104** may block or limit access to right-side face **106c**, left side-face **106d** and/or back-face **106b**. In some embodiments, access to the other faces **106b-106f** may be provided by sliding or otherwise removing brewing device **102**, and/or adjacent devices, at least partially out of rack-mount **104**. Accordingly, access to brewing device **102** may be limited to front-face **106a**.

FIG. 3A illustrates brewing device **102** in accordance with one or more embodiments of the present technique. In the illustrated embodiment, supply container **110** includes a cylindrical bottle having a longitudinal axis **122**, a necked portion **124**, and a nozzle **126**. During use, supply container **110** may be coupled to brewing device **102** by inserting/engaging nozzle **126** with fill-port **108**. In the illustrated embodiment, fill-port **108** includes a complementary nozzle located on front-face **106a** of housing **106**. More specifically, fill-port **108** includes a complementary nozzle **130** having a hollow cylindrical recess that may accept nozzle **126**. In the illustrated embodiment, nozzle **126** includes a threaded engagement feature **128**. In the illustrated embodiment, complementary nozzle **130** includes a complementary engagement feature **132** that is threaded to mate with the threads of engagement feature **128**. Engagement features **128** and **132** may include standard right hand or left hand threads and/or include detent features, such that nozzle **126** of supply container **110** may be inserted into nozzle **130** of fill-port **108**, and supply container rotated about longitudinal axis **122** to engage fill-port **108**. In certain embodiments, threads and/or detent features may be employed such that supply container **110** may be rotated a portion of turn (e.g., one-eighth of a turn, on-quarter of a turn, half of a turn, three-quarters of a turn), or one or more turns to engage fill-port **108**. In some embodiments, fill-port **108** may include a shape that assists with the insertion of supply container **110**. For example, an end of fill-port **108** in which supply container **110** is inserted (e.g., the end proximate front face **106a**) may include a chamfered edge or similar shape that helps to capture/direct nozzle **126** of supply container **110** into nozzle **130** of fill-port **108**.

In other embodiments, an engagement feature may not be provided on one or both of supply container **110** and fill-port **108**. For example, in one embodiment, nozzle **126** may be inserted into the recess of nozzle **130** and remain coupled to one another via a friction fit, interference fit or some other force. In one embodiment, the outside diameter of nozzle **126** may be slightly less than, equal to, or slightly larger than the inside diameter of nozzle **130** such that a tight/interference fit is created between nozzle **126** of supply container **110** and nozzle **130** of fill-port **108**. The tight/interference fit may help to retain supply container **110** such that it does not easily

dislodge from fill-port **108** once inserted. In some embodiments, additional elements may be employed to create a tight/interference fit. For example, sealing elements may be disposed on the inside diameter of nozzle **130** to create interference (e.g., contact) with nozzle **126** of supply container **110**. For example, elastomeric seals may be employed with an inside diameter less than the outside diameter of nozzle **126** of supply container **110**. When nozzle **126** is inserted into nozzle **130**, the seals may deflect around nozzle **126** to create an interference fit that helps to retain supply container **110** and may also provide sealing between nozzle **126** and nozzle **130**. The interference fit may be employed such that supply container **110** can be inserted into and removed from fill-port **108** with a reduced force that enables an operator (e.g., a flight attendant) to quickly and easily remove, insert, and/or exchange supply containers.

As mentioned briefly above, in one embodiment, one or more sealing elements may be provided between the supply container **110** and fill-port **108** to reduce the likelihood of fluid (e.g., water) spilling or leaking. For example, in the illustrated embodiment, a first sealing element **134a** and a second sealing element **134b** are disposed in the interior of nozzle **130**. Sealing elements **134a** and **134b** may provide a complete or partial fluid seal between the interior surface of nozzle **130** and the exterior surface of nozzle **126** when supply container **110** is inserted into fill-port **108**. In one embodiment, sealing elements **134a** and **134b** may each include a circular ring formed from an elastic material (e.g., a plastic or polymeric ring) to provide a seal between an interior face of nozzle **130** of fill-port **108** and an end of nozzle **126** of supply container **110**. In other embodiments, additional sealing elements may be used, only one of sealing element **134a** and **134b** may be used, or no sealing elements may be used. Further, sealing elements **134a** and **134b** or other sealing elements may provide an interference fit that helps to retain supply container **110**, as described above.

In one embodiment, supply container **110** may include a cover that helps to prevent water from leaking from supply container **110** before it is installed in and after it is removed from fill-port **108**. FIG. 3B illustrates a penetrable cover that is pierced punctured, or otherwise opened by a complementary feature of fill-port **130**. As depicted, supply container **110** includes a nozzle cover **135** disposed over an opening of nozzle **126**. Nozzle cover **135** may act to retain fluid from leaking from supply container **110** before it is installed in fill-port **108**. In one embodiment, nozzle cover **135** may include a solid medium that is not punctured, or a medium that is perforated or previously punctured. Nozzle cover **135** may be formed from an elastomeric material (e.g., a plastic or rubber). Nozzle cover **135** may be preinstalled on each of supply containers **110**, or may include a removable component that is exchanged from one supply container to at or near the time of use. During use, nozzle cover **135** may be penetrated by a protrusion **137** located in or near fill-port **108**. For example, in the illustrated embodiment, protrusion **137** is located in a rear portion of nozzle **132** and is arranged to puncture, or otherwise open nozzle cover **135** to enable fluid to flow from container **110** when supply container **110** is installed in fill-port **108**. When supply container **110** is removed from fill-port **108**, the absence of the protrusion may enable nozzle cover **135** to substantially or completely close, thereby limiting fluid leakage from supply container **110**.

Returning now to FIG. 3A, fill-port **108** may be located above a reservoir or other fluid containment device such that fluid (e.g., water) is gravity fed from supply container **110** into brewing device **102**. For example, in the illustrated embodiment fill-port **108** is located above a reservoir of brew-

ing device **102**, such that fluid poured into fill-port **108** is gathered and routed via a conduit to a reservoir. In the illustrated embodiment, fill-port **108** includes a cylindrical shape that acts as a funnel to direct the water into a conduit for use in brewing device **102**. In other embodiments, the shape of fill-port **108** may be modified to further assists the routing of water to the interior of brewing device **102**. For example, fill-port **108** may include a funnel shaped portion **135** (e.g., a cone shape at the end proximate an outlet **136** of fill-port **108**), ridges, grooves, channels, or the like to help direct water to the conduit. For example, the interior surface of nozzle **130** may include channels that direct water to the outlet **136** of fill-port **108** proximate the conduit.

In one embodiment, fill-port **108** is in fluid communication with a reservoir or a similar fluid containment device for directing fluid to other components of brewing device **102** (e.g., a heating device). In the illustrated embodiment, fill-port **108** is coupled to a reservoir **140** via a conduit **142**. Conduit **142** extends from outlet **136** of fill-port **108** to an inlet **144** of reservoir **140**. Fluid routed through conduit **142** may be gravity-fed downward into reservoir **140** in the direction of arrow **145**. In one embodiment, conduit **142** includes a rigid, semi-rigid or flexible hollow tube. For example conduit **142** may be formed from metal tubing (e.g., copper tubing, plastic tubing, or elastomeric tubing).

Reservoir **140** may be used to store fluids for use in brewing. For example, reservoir **140** may hold a volume of water equal to or greater than the volume of water needed for a single brewing cycle. In other words, reservoir **140** may hold enough water for one, two, three, four, five, six, seven, eight, nine, ten or more brewing cycles. Each brewing cycle may be capable of producing one or more servings of a beverage. For example, each brewing cycle may be capable of producing enough of a brewed beverage for one, two, three, four, five, six, seven, eight, nine, ten, eleven, twelve, or more cups of coffee. In another embodiment, reservoir **140** may hold a volume of water for a single brewing cycle or a single serving or less. For example, in one embodiment, reservoir **140** may hold only enough water for a single serving of a brewed beverage.

In one embodiment, brewing device **102** may not include a reservoir of substantial volume, or may not have a reservoir at all. For example, in one embodiment, brewing device **102** may include a conduit that extends directly from outlet **136** of fill-port **108** to another component (e.g., heating device) of brewing device **102**. Such an embodiment may rely on the volume of water contained in conduit **142** and/or supply container **110** to acts as a reservoir and/or fluid supply for brewing.

In one embodiment, reservoir **140** may include one or more devices that are capable of detecting a water level in reservoir **140**. In the illustrated embodiment reservoir **140** includes a sensors **146** located on interior top, bottom, and wall/side surfaces of reservoir **140**. Embodiments may include any number of sensors **146**. For example, a single sensor **146** may be located at or near a bottom surface of reservoir **140**. Each sensor **146** may be operated to detect whether or not the water level in reservoir **140** is low (e.g., empty) or high (e.g., full) or in-between (e.g., low). In one embodiment, sensor **146** includes a pressure sensor. In such an embodiment, sensor **146** may include a pressure sensor/transducer that is disposed in the fluid reservoir/container such that it is submerged when fluid is contained in the reservoir/container. For example, sensor **146** may be located on a bottom-interior surface of reservoir **140** and/or on a side of reservoir **140** at or below an expected water level. Sensor **146** may be capable of sensing and transmitting data indicative of the hydrostatic pressure of

water at or above the level of sensor **146**. For example sensor **146** may include a diaphragm that is capable of sensing the hydrostatic pressure of the water. One or multiple sensors **146** may be included at other locations (e.g., at different points on the bottom of the reservoir/container, or located at various heights along a wall/side of the reservoir/container) to more accurately gather fluid/water level data. In one embodiment, sensor **146** includes an ultra-sonic sensor used to assess the fluid/water level. In such an embodiment, ultrasonic sensor **146** may generate an ultrasonic signal that reflects off of the fluid/water, and a fluid/water level may be assessed and determined based at least on the time it takes for the reflected signal to return to sensor **146**. Processing of the signal may be provided in additional circuitry of brewing device **102**, discussed in more detail below. Other embodiment may include any number of additional types, combinations, and locations of sensors. For example, other embodiments may include any combination of pressure and ultrasonic sensors **146** suspended inside reservoir **140**, located on or proximate the interior or exterior side, top, or the bottom surfaces of reservoir **140**.

In one embodiment, water is routed from reservoir **140** to a pump **148**. Pump **148** may include a fluid pump capable of advancing water from an outlet of reservoir **140** to a heater **150** or other downstream devices. For example, in the illustrated embodiment, water routed into heating device **150** is gravity-fed from an outlet **152** reservoir **140**, to pump **148** in the direction of arrow **155**. Pump **148** may generate water flow from reservoir **140** to heater **150** in the direction of arrow **155**. The resulting flow may include a sufficient pressure such that the water is directed into an inlet **154** of heater **150** via conduit **151**. In the illustrated embodiment, pump **148** is coupled directly to outlet **152** of reservoir **140**. In one embodiment, pump **148** may be located inside of or integral with reservoir **140**, or coupled to outlet **152** via a conduit such that it is outside of and not directly coupled to outlet **152**. In the illustrated embodiment, pump **148** is located substantially at or near the base (e.g., bottom surface) of reservoir **140** such that substantially all of the fluid in reservoir **140** can be gravity fed to pump **148**. In one embodiment, pump **148** may be located above/elevated with respect to the base of reservoir **140**. In such an embodiment, pump **148** may induce a suction that is capable of drawing the water up to an inlet of pump **148**. In an embodiment in which there is no reservoir, conduit **142** may couple directly to inlet pump **148**.

In one embodiment, a pump may not be used and heating device **150** may be gravity fed directly from reservoir **140**. In such an embodiment, may be gravity-fed into the heating device **150** in the direction of arrow **155**. For example, conduit **151** may extend directly from an outlet **152** near the base of reservoir **140** to an inlet **154** of heating device **150**. In one embodiment, outlet **152** of reservoir **152** may be coupled directly to inlet **154**. In an embodiment in which there is no reservoir, conduit **142** may couple directly to inlet **154**.

Heating device **150** may be used to heat the water to a temperature suitable for brewing. Water for coffee, for example, may be heated in a range of about **195** to **205** degrees Fahrenheit, although other heating temperatures are contemplated. In one embodiment, heating device **150** includes a heat exchange device, such an electric coil that transfers energy in the form of heat to the water. The heated water is routed to a brewing station **160** via a conduit **162**. In the illustrated embodiment, conduit **162** extends between exit **164** of heating device **150** and inlet **166** of brewing station **160**. Pump **148** may create a sufficient fluid flow and pressure to raise the water through conduit **162** to brewing station **160**.

In one embodiment, heating device **150** may heat a reservoir of fluid. For example, heating device **150** may include one or more heating elements located adjacent or inside of reservoir **140**. In such an embodiment, heat may be transferred from heating device **150** into the fluid located in reservoir **140**, such that the fluid is heated while it is located within reservoir **140**.

Brewing station **160** may include a portion of brewing device **102** that enables the heated water to interact with a brewing medium to generate the heated beverage. For example, in an embodiment in which brewing device **102** is a coffee maker, brewing station **160** may include a basket used to hold ground coffee beans. In such an embodiment, brewing station **160** may also include a replaceable filter that holds the ground coffee beans and enables the heated water to pass slowly over the coffee beans to acquire the flavor of the coffee beans. Once the heated water has been sufficiently brewed into coffee, it may exit brewing station **160** and is dispensed into serving container **112**. For example, in the illustrated embodiment, the brewed beverage (e.g., coffee) is dispensed from an outlet **168** of brewing station **160** into an opening of serving container **112**. In an embodiment used to provide only a heated fluid (e.g., a fluid not brewed, such as hot water), the heated fluid may be routed around brewing station **160**, or a brewing station may not be present, such that the heated fluid is routed from heating device **150** directly to outlet **168** or another outlet of brewing device **102**.

In one embodiment, serving container **112** may include a coffee pot that is capable of one or more servings of coffee or a similar brewed beverage. In another embodiment, serving container may include a cup, bottle, mug, or similar container that holds one or more servings of a brewed beverage (e.g., one or several cups of coffee).

Brewing device **102** may also include one or more others features conducive to safe operation. For example, in the illustrated embodiment, a retainer **170** extends across an opening in front face **106a** to retain serving container **112**. In one embodiment, retainer **170** may include a bar-shaped member or protrusion that extends at least partially across the opening **107** where serving container **112** is located (see FIG. 1). Retainer **170** may be movable such that an operator (e.g., a flight attendant) may easily engage/disengage retainer **170**. Such a device may help to prevent serving container **112** from falling, spilling, or moving, during landing, takeoff, and turbulence, for instance.

In the illustrated embodiment, brewing device **102** includes a heating pad **172**. Heating pad **172** may include a heating device that is used to heat the contents of serving container **112** while it is seated in opening **107**. In one embodiment, heating pad **172** may include an electrical heating element that remains energized for a predetermined period of time after a brew cycle, as long as the brewing device is on, based on a selection of an operator, and/or based on whether or not a serving container is present. In one embodiment, heating device **150** and heating pad **172** may share common heating components. For example, a single coil may be employed for heating both.

Brewing device **102** may also include a serving container detection device **174**. Such a device may be used to assess and determine whether or not serving container **112** is present. For example, in one embodiment, brewing device **102** includes supply container detection device **174** located proximate the expected seated location of serving container **112** (e.g., in the back of the opening for supply container **112**). In one embodiment, serving container detection device **174** includes an electrical sensor (e.g., a proximity sensor/switch or an ultrasonic sensor), a mechanical switch (e.g., an articu-

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lating arm) that can detect whether or not serving container 112 is present. Such a device may enable brewing device 102 to adjust operation to prevent accidental spill, leaks, and the like. For example brewing device 102 may prevent the beverage from being dispensed from outlet 168 and/or suspend a brewing cycle when a serving container is not present or properly seated in opening 107. Further, operation of heating pad 172 may be based on whether or not a serving container is present and/or properly seated.

In one embodiment, brewing device 102 may also include one or more devices that are capable of detecting a beverage level in serving container 112. For example, the illustrated embodiment includes a sensor 176 located on a bottom surface of brewing station 160. Sensor 176 may be operated to detect whether or not the beverage level in serving container 112 is low (e.g., empty) or high (e.g., full) or in-between (e.g., low). In one embodiment, sensor 176 may include an ultrasonic sensor used to assess the beverage level. The ultrasonic sensor may generate an ultrasonic signal that reflects off of the beverage, and a beverage level may be assessed and determined based at least on the time it takes for the reflected signal to return to sensor 176. Processing of the signal may be provided by circuitry of brewing device 102, discussed in more detail below. Other embodiments may include any number of additional types and locations of sensors. For example, one embodiment may include one or more sensors 176 (e.g., pressure or ultrasonic sensors) located on the sides or bottom of the opening for serving container 112, integrated with heating pad 172, integrated with serving container 112, or a combination thereof.

As depicted, brewing device 102 may also include control device 180. In one embodiment, control device 180 may include power circuitry, such as a power receptacle for receiving and distributing power to various components (e.g., heating device 150) of brewing device 102. In one embodiment, control device 180 may include an inverter, rectifier, transformer, switches, or the like. Control device 180 may also include control circuitry used to control operation of brewing device 102. For example, control device 180 may include electrical circuitry that controls the brewing characteristics (e.g., brewing time and temperature) as well as various sensors of brewing device 102. In one embodiment, control circuitry may include a memory device, integrated circuits, or other similar devices that store and/or implement operational routines or software. Control circuitry may be used to send and/or receive outputs and/or inputs to and from a user (e.g., via controls 114), to send and/or receive outputs and/or inputs to and from sensors (e.g., sensors 146 and 176) and the like.

Operation of brewing device 102 may be varied in some embodiments. In some embodiment, a single brewing cycle may be used to brew all of the water in reservoir 140. For example, in one embodiment, heating device 150 may be operated until all of the water in the reservoir has been heated and brewed. In another embodiment, a single brewing cycle may brew less than all of the water in reservoir 140. Such operation may be particularly well suited where smaller servings are desired, and/or where the amount of water in reservoir 140 is greater than the capacity of serving container 112. One embodiment may include "on-demand" operation of the heating device. For example, the heating device 150 may include an in-line heat exchanger that is selectively operated to heat only enough water for a desired serving size (e.g., a single cup of coffee). In such an embodiment, an operator (e.g., a flight attendant) may provide a request for a single cup of coffee by pressing one of controls 114 to prompt brewing device 102 to heat and brew a single serving of a beverage that is dispensed into serving container 112. This may be useful

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when only single serving is desired and it would otherwise be wasteful to heat a greater quantity of water. For example, an aircraft may only have a limited amount of water available for brewing coffee. Such operation may also reduce the amount of heated water stored on an aircraft at any given time, thereby reducing risk of heated fluids contacting passengers or operators during unexpected flight conditions, such as a crash or turbulence.

FIG. 4 is a perspective view of brewing device 102 in accordance with one or more embodiments of the present technique. In the illustrated embodiment, brewing device 102 includes housing 106, fill-port 108, controls 114, outlet 168, heating pad 172, serving container detection device 174, and severing retainer 170. In the illustrated embodiment, each of back face 106b, right face 106c, left face 106d, top face 106e, and bottom face 106f does not include any portion or controls of brewing device 102 that may require access by an operator during normal operation. For example, faces 106b-f do not include a fill-port, controls, an opening for a serving container, or the like that may be used by an operator during filling, serving and/or regular cleaning/maintenance. As discussed above, faces 106b-f of brewing device 102 may be obstructed by rack-mount 104 and/or other adjacent devices (such as other brewing devices or modular devices) when brewing device 102 is installed in rack-mount 104. Fill-port 108 and controls 114 are located on or substantially near front-face 106a of housing 106. Accordingly, fill-port 108 and controls 114 are accessible from a front side of brewing device 102 even when brewing device 102 is installed in a rack-mount as described with respect to FIG. 1.

In the illustrated embodiment, controls 114 include buttons labeled as "1/2 POT", "BREW", "TEA", "HOT WATER", and "ON/OFF". Controls 114 also include LEDs labeled "FULL", "HALF", and "LOW". In one embodiment the "1/2 POT" button may be depressed to brew one-half pot of coffee, the "BREW" button may be depressed to start and stop a brewing cycle, the "TEA" button may be depressed to brew tea as opposed to coffee, the "HOT WATER" button may be depressed to provide heated water that is not passed over a brewing medium, and the "ON/OFF" button may be depressed to toggle power to the brewing device 102 on and off. In one embodiment, the LEDs may be lit to indicate a level of water or other fluid in the reservoir 140. For example, sensor 146 may provide a signal indicative of the fluid level to control circuitry 180, and control circuitry 180 may control which LED is lit. Such a feature may be useful for an operator to quickly assess whether or not water needs to be added to the brewing device 102.

In the illustrated embodiment, fill-port 108 is located at least partially within opening 107. A top portion of fill-port 108 is located in a cutout 182 in a right side of front face 106. In the illustrated embodiment, fill-port 108 is angled relative to the horizontal plane such that fluid poured into fill-port 108 is gravity fed to outlet 136. More specifically, fill-port 108 angles downward from its front end to its back end (e.g., higher at the end where supply container 110 is inserted and lower at the side where outlet 136 is located).

Further, fill-port 108 includes a cover 184 that can be used to open and close nozzle 132 of fill-port 108. For example, cover 184 is rotatably coupled to the lower-front edge of fill-port 108 such that it may rotate upward to cover the opening of nozzle 132, and may rotate downward to provide access to the opening of nozzle 132. In the illustrated embodiment, cover 184 is rotatably coupled by a hinge mechanism 186 and biased to a closed position via a biasing member 188. The hinge mechanism 186 may include a pin running along the rotating axis of hinge mechanism 186. In other embodi-

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ments, hinge mechanism **186** may include a living hinge or similar hinge device that enables rotation of cover **184** relative to fill-port **108**. In one embodiment, cover **184** may not be biased into one or both of the opened and closed positions. In the illustrated embodiment, biasing member **186** includes a torsional spring disposed between cover **184** and the body of fill-port **108**. Other embodiments may include linear springs, or similar elastic members configured to bias cover **184** open and/or closed.

A method of operating brewing device **102** in accordance with one or more embodiments of the present technique may include providing fluid via front side of the brewing device, routing fluid from the fluid supply to a reservoir and/or a heating device, heating the fluid to a desired temperature, brewing and/or dispensing the resulting brewed beverage for serving. In one embodiment, providing fluid via front side of the brewing device may include inserting at least a portion of supply container **110** into fill-port **108** such that fluid may be transferred from supply container **110** to brewing device **102** via fill-port **108**. In some embodiment, inserting at least a portion of fluid supply container **110** may include threading or otherwise engaging engagement/sealing features of supply container **110** with complementary engagement/sealing features of fill-port **108**. In one embodiment, routing the fluid from the fluid supply to a reservoir and/or a heating device may include routing fluid via conduit **142** from outlet **136** to inlet **144** of reservoir **140** and from outlet **152** of reservoir **140** to inlet **154** of heating device **150** via conduit **151**. Heating the fluid to a desired temperature may include performing a brewing cycle to heat multiple servings of a beverage (e.g., heating all or at least a portion of the fluid contained in reservoir **140**) or performing a brewing cycle to heat only a single serving of a beverage (e.g., on-demand heating of the fluid). Heating the fluid may include heating the fluid to a temperature of 195 to 205 degreed Fahrenheit. Brewing and/or dispensing the resulting brewed beverage for serving may include passing the heated fluid over a brewing medium in brewing station **160** and dispensing the brewed beverage from outlet **168** into serving container **112** from which the beverage can be served. As is apparent each of the steps that may be performed by an operator, such as providing fluid and accessing the serving container may be accomplished with only access to the front face/side of the brewing device. Such a method may be desired because it does not require access to portions of the brewing device that are not easily accessed (e.g., obstructed by an associated rack-mount or adjacent devices).

Although the above discussion has provided some descriptions with respect to brewing devices, such as coffee makers used in aircraft, the present technique may be adapted for use in any number of applications. For example, the described features may be employed in home use and commercial establishments, as well as for use in any number of transportation vehicles including but not limited to commercial aircraft, private aircraft, trains, buses, recreational vehicles, and the like. Further each of the described techniques may be adapted for use with any similar form of brewed/heated beverages, such as coffee, tea, cappuccino, espresso, hot chocolate, hot water, and the like.

Further modifications and alternative embodiments of various aspects of the invention will be apparent to those skilled in the art in view of this description. Accordingly, this description is to be construed as illustrative only and is for the purpose of teaching those skilled in the art the general manner of carrying out the invention. It is to be understood that the forms of the invention shown and described herein are to be taken as examples of embodiments. Elements and materials may be substituted for those illustrated and described herein,

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parts and processes may be reversed or omitted, and certain features of the invention may be utilized independently, all as would be apparent to one skilled in the art after having the benefit of this description of the invention. Changes may be made in the elements described herein without departing from the spirit and scope of the invention as described in the following claims. It is to be understood that the terminology used herein is for the purpose of describing particular embodiments only, and is not intended to be limiting. As used in this specification, the singular forms “a”, “an” and “the” include plural referents unless the content clearly indicates otherwise. Thus, for example, reference to “a nozzle” includes a combination of two or more nozzles.” The words “include”, “including”, and “includes” mean including, but not limited to.

What is claimed is:

1. A beverage brewing device, comprising:

a housing; and

a fill-port located on a front side of the housing, wherein the fill-port comprises an inlet configured to accept to a fluid supply containers;

wherein the front side comprises a side of the beverage brewing device housing that faces toward a user when the brewing device is installed in a rack-mount;

wherein the beverage brewing device comprises a modular brewing device configured to be installed in an aircraft rack-mount having a top-rack portion that blocks access a top face of the housing.

2. The beverage brewing device of claim 1, wherein the fill-port is accessible to receive fluid from a supply container when the beverage brewing device is installed for use.

3. The beverage brewing device of claim 1, wherein the fill-port comprises a nozzle.

4. The beverage brewing device of claim 3, wherein the nozzle of the fill-port is complementary to a nozzle of the fluid supply container.

5. The beverage brewing device of claim 3, wherein the nozzle of the fill-port comprises an inner diameter larger than an outer diameter of the nozzle of the fluid supply container, such that the nozzle of the fluid supply container may be slid into the nozzle of the fill-port.

6. The beverage brewing device of claim 1, wherein the fill-port comprises an engagement feature configured to engage a complementary engagement feature of the fluid supply container.

7. The beverage brewing device of claim 6, wherein the engagement feature comprises a protrusion configured to puncture a portion of the fluid supply container.

8. The beverage brewing device of claim 1, wherein the fill-port is located in a recess of the front side.

9. The beverage brewing device of claim 8, wherein the recess is configured to house all or substantially all of the fluid supply container.

10. The beverage brewing device of claim 1, wherein the fluid supply container comprises a shape substantially complementary to a shape of the recess.

11. The beverage brewing device of claim 1, wherein the beverage brewing device does not comprise a fill-port on a top side of the brewing device.

12. The beverage brewing device of claim 1, wherein the fluid supply container comprises a bottle for bottled water, and wherein the inlet comprises a nozzle configured to mate with a nozzle of the bottle.

13. The beverage brewing device of claim 1, comprising a fluid pump configured to generate fluid flow from a water source to a water heater of the beverage brewing device.

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14. The beverage brewing device of claim 1, comprising a pressure sensor configured to detect a fluid level in a reservoir of the beverage brewing device.

15. A beverage brewing system, comprising:

an aircraft rack-mount comprising one or more modular slots configured for securing one or more modular devices; and

a modular brewing device configured to fit within the aircraft rack-mount, wherein the modular brewing device comprises:

a housing configured to be secured within the aircraft rack-mount, wherein a front side of the housing is substantially accessible by a user when the housing is secured within the aircraft rack-mount; and

a fill-port located on the front side of the housing, wherein the fill-port is substantially accessible when the housing is secured within the one or more modular slots, and wherein the fill-port comprises an inlet configured to accept a fluid supply container;

wherein the aircraft rack-mount has a top-rack portion that blocks access a top face of the housing.

16. The system of claim 15, further comprising the fluid supply container.

17. The system of claim 15, wherein the fill-port comprises a nozzle.

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18. The system of claim 17, wherein the nozzle is complementary to a nozzle of the fluid supply container.

19. The system of claim 15, wherein the fill-port comprises an engagement feature configured to engage a complementary engagement feature of the fluid supply container.

20. The system of claim 19, wherein the engagement feature comprises a thread or a detent feature.

21. The system of claim 19, wherein the engagement feature includes a protrusion configured to puncture a portion of the fluid supply container.

22. The beverage brewing device of claim 15, wherein the fill-port is located in a recess of the front side.

23. The beverage brewing device of claim 22, wherein the recess is configured to house all or substantially all of the fluid supply container.

24. The beverage brewing device of claim 15, wherein the fluid supply container comprises a shape substantially complementary to a shape of the recess.

25. The beverage brewing device of claim 15, wherein the modular beverage brewing device does not comprise a fill-port on a top side of the brewing device.

26. The beverage brewing device of claim 15, wherein the fluid supply container comprises a bottle for bottled water.

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